THREE-DIMENSIONAL (3D) RENDERING METHOD AND APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims the benefit under 35 USC §119(a) of Korean Patent Application No. 10-2015-0106829, filed on Jul. 28, 2015, in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference for all purposes.

BACKGROUND

[0002] 1. Field

[0003] The following description relates to three-dimensional (3D) computer graphics technology.

[0004] 2. Description of Related Art

[0005] Three-dimensional (3D) computer graphics refer to computer graphics including three-dimensionally expressing a model using geometric data stored in a computer and processing and outputting the three-dimensionally expressed model as a 2D resulting product. The geometric data of the model may include information on a location of each point forming the model. In the 3D computer graphics, 3D rendering refers to a process of transforming a 3D model to a 2D image, which includes calculating a light flow to obtain a photorealistic image or performing non-photorealistic rendering (NPR) to obtain a resulting product. The 3D rendering refers to a process of determining a set of coordinates and a color of a pixel to be output to a display using points, for example, vertices, forming a model and information about a relationship among the points.

SUMMARY

[0006] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0007] In one general aspect, there is provided a three-dimensional (3D) rendering method including determining a vertex for a first shading from among vertices of a 3D model based on characteristic information of the 3D model, performing the first shading on the determined vertex, determining a pixel area for a second shading based on reference information, performing the second shading on the determined pixel area, and generating a rendered image based on the first shading and the second shading.

[0008] The determining of the vertex for the first shading may include determining the vertex based on a length of an edge between a vertex and a neighboring vertex of the 3D model.

[0009] The determining of the vertex for the first shading may include determining the vertex based on an area of a polygon formed with the vertex.

[0010] The method may include dividing a surface of the 3D model into a plurality of areas in response to a determination of an applicability of a surface subdivision to the 3D model, and the determining of the vertex for the first shading comprises determining the vertex based on the divided the 3D model.

[0011] The dividing of the surface of the 3D model may include adding at least one vertex to the surface of the 3D model.

[0012] The reference information may indicate whether the first shading is applied to at least one vertex comprising the pixel area.

[0013] The determining of the pixel area for the second shading may include determining the pixel area based on the reference information and a threshold value.

[0014] The determining of the vertex may include determining the vertex to which the first shading is to be applied based on at least one of information about a vertex density of the 3D model, information about an area of a polygon formed by vertices of the 3D model, information about a distance among vertices to be projected to a screen space, information about an area of a polygon to be projected to the screen space, or information about a distance between a vertex and a virtual light source.

[0015] The characteristic information of the 3D model may be determined based on at least one of vertex information of the 3D model, location information of a virtual camera, direction information of the virtual camera, location information of a virtual light source, or direction information of the virtual light source.

[0016] The first shading may be determined in a vertex unit of the 3D model, and the second shading may be determined in a pixel unit of an image frame in which the 3D model is expressed.

[0017] The determining of the pixel area for the second shading may include determining the pixel area based on a speed at which rendering is performed on the 3D model and the reference information.

[0018] In another general aspect, there is provided a 3D rendering apparatus including a determiner configured to determine a vertex for a first shading from among vertices of a 3D model based on characteristic information of the 3D model, a first shader configured to perform the first shading on the determined vertex, a second shader configured to determine a pixel area to apply a second shading based on reference information, and to perform the second shading on the determined pixel area, and a rendered image generator configured to generate a rendered image based on the first shading and the second shading.

[0019] The first shader may be configured to allocate, to each vertex of the 3D model to be projected to a screen space, a vertex attribute value indicating whether the first shading is performed.

[0020] The determiner may include a divider configured to determine whether a surface subdivision is applicable to the 3D model, and may divide a surface of the 3D model into a plurality of areas in response to the applicability of the surface subdivision.

[0021] The first shading may be determined in a vertex unit of the 3D model, and the second shading may be determined in a pixel unit of an image frame in which the 3D model is expressed.

[0022] The determiner may be configured to determine the vertex for the first shading, in response to a distance between the vertex and the virtual light source is less than a threshold value.

[0023] In accordance with another aspect, there is provided a 3D rendering apparatus including a determiner configured to determine whether to apply a first shading or a second shading to a current image frame, a first shader